Inorganic Antibacterial Materials

F. Ciraldo[1], A.R. Boccaccini [1]

[1] Institute of Biomaterials, Department of Materials Science and Engineering, Friedrich-Alexander University Erlangen-Nuremberg, Erlangen, Germany

aldo.boccaccini@ww.uni-erlangen.de

Antibacterial infections are one of the main complications after surgery. Conventional treatments (e.g. administration of antibiotics) are often characterized by lack of effectiveness, low delivery efficacy, high toxicity and other inconveniences for the patient. They can also lead to the development of drug-specific resistance by bacteria. Mesoporous bioactive glasses (MBGs) in the $CaO–SiO_2–P_2O_5$ system were reported for the first time more than 10 years ago. The tunable and ordered pores, the high specific surface area and the high pore volume make MBGs optimal candidates for the local delivery of biologically active molecules.

In the past 10 years, different therapeutic ions, such as monovalent (Ag and Li), divalent (Sr, Zn, Cu, Co and Mg), trivalent (Ga, Ce and Fe) and tetravalent (Zr) ions, have been introduced in silicate matrices to develop bioactive glasses with biologically active ions release. The therapeutic ions can be easily incorporated in the framework and at the same time allow the material to maintain its well-ordered mesoporous structure, ideal for drug delivery. The release of ions can have various effects such as enhancing osteogenesis, promoting angiogenesis and cementogenesis or providing antibacterial activity, offering a multifunctional platform for applications in orthopedics and hard tissue regeneration.

In this work different MBG compositions were produced by sol-gel technique and specific concentrations of antibacterial ions were introduced during the synthesis process. Full characterization of the inner microstructure, specific surface area, pore size distribution and pore volume of the samples by TEM, BET and BHJ was performed. The samples were then characterized by soaking in simulated body fluid (SBF) in order to study their ability to form a hydroxycarbonate apatite layer (HCA) on their surface. SEM, FTIR and XRD were used to characterize the glasses after the immersion in SBF. The control of MBG dissolution, ion and biomolecule release capability and the effect of HCA formation will be discussed.